

REMARKS/ARGUMENTS

Claims 8 through 12 remain pending in this application.

Claims 1 through 7 have been withdrawn, without prejudice or disclaimer to the subject matter contained therein. The previously pending claims have been withdrawn and new claims 8 through 12 have been added to the application in order to have the claims of the present application correspond to the claims of the related UK patent application, which has issued as UK Patent No. GB2342996. In the applicant's respectful submission, no new matter has been added to the application as a result of the amendments to the claims. The amendments have not been made in response to a statutory requirement.

In the Examiner's Report dated November 19, 2003, the Examiner objected to the absence of an abstract. The foregoing amendments to the specification provide an abstract as required by 37 C.F.R. 1.72(b).

In the Examiner's report of November 19, 2003, the Examiner rejected claim 1 of the present application as being anticipated by U.S. Patent No. 4,308,599 (Thiele). The Examiner also rejected claims 1 and 3-7 as being anticipated by U.S. Patent No. 4,894,661 (Furuno et al.). The Examiner then rejected claim 2 as being anticipated by Furuno et al. in combination with U.K. Patent Publication No. 2,306,003 (Cherek et al.).

The applicant has carefully considered the Examiner's rejections but respectfully traverses the rejections for the following reasons.

The Thiele reference teaches an echo sounding system for sensing and differentiating between hard and soft layers at the sea bottom. Thiele notes that in the prior art it is suggested to use a high frequency and a low frequency transmission. However, Thiele teaches away from this method since transmitted low frequency acoustic energy has a

wide directional characteristic compared to the high frequency energy. Thiele teaches a system in which two slightly different high frequency pulses are transmitted. The pulses combine during transmission through the medium to produce a low frequency difference pulse. The system described in Thiele includes a low frequency transducer for receiving the low frequency difference signal and a high frequency transducer for receiving one of the transmitted high frequencies. Both of the received signals are displayed on a screen or plot so as to indicate the hard and soft layers of the sea bottom. It does not appear that Thiele teaches or suggests creating a profile from a combination of the received signals.

The Furuno et al. reference teaches a fish detector that uses radar to locate flocks of circulating sea birds which are often located over a school of fish. Furuno et al. suggests a system that operates at two carrier frequencies: the S-band and the X-band. Larger objects such as islands and ships reflect both frequencies whereas birds only reflect one of these frequencies. The system described by Furuno et al. processes the received echoes separately and displays a separate trace for each signal. Objects indicated by one trace and not the other may be presumed to be sea birds. It does not appear that Furuno suggests summing or differencing the received signals or in any other way combining them, other than through displaying them on the same screen. The traces are intended to overlap so that the echoes corresponding to the sea birds have a colour different from other echoes.

The present invention, as defined in claim 8, is directed to a method of operating a pulse echo ranging system that includes steps of transmitting at least two energy pulses having substantially different frequencies, receiving reflected echoes (received signals), and combining the received signals to provide enhanced data. Neither of the cited references teaches the step of combining received signals to provide enhanced data. Accordingly, the applicant respectfully submits that neither of the references anticipate the present invention.

Moreover, there is no motivation for one of ordinary skill in the art to modify the teachings of Furuno et al. or Thiele in order to combine the received signals to provide enhanced data. The Thiele reference teaches the transmission of two high frequency pulses having slightly different frequencies, which will combine in the medium to produce a low frequency difference pulse. Accordingly, Thiele teaches away from the present invention, which includes transmitting two energy pulses having substantially different frequencies and combining the received signals to provide enhanced data. The Furuno et al. reference is directed to a different problem and field than the present invention. Furuno et al. contemplates detecting schools of fish by radiating radio search signals successively in different azimuthal directions through a wide angular range in order to locate flocks of birds. This is a far different application and problem than is addressed by the present invention. The present invention is directed to a pulse echo ranging system for use in level measurement applications. Accordingly, the applicant respectfully submits that one of ordinary skill in the art would not be inclined to modify the Furuno et al. device to arrive at the present invention. Moreover, Furuno et al. neither teaches nor suggests combining the received signals. Furuno et al. limit their teachings to the receipt of separate reflected echoes and displaying each reflected echo signal separately and independently.

The cited Cherek reference teaches the use of a frequency to render the radiating surface of the transducer self cleaning. The teachings of the Cherek reference do not cure the deficiencies of the cited Thiele and Furuno et al. references. Accordingly, in the applicant's respectful submission, claim 8 of the present application is patentably distinguishable over Thiele, Furuno et al., or Cherek, alone or in combination. For the same reasons, claims 9 through 12 of the present application are also patentably distinguishable over the cited references.

In view of the foregoing amendments and submissions, the applicant respectfully requests reconsideration and allowance of the present application. Should the Examiner have any questions with regard to the submissions, please contact Bill Vass at 416-868-1482.

Respectfully Submitted,

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ABSTRACT

A method of operating a pulse echo ranging system comprising a transducer assembly for providing transmission and reception of high frequency energy pulses at substantially different plural frequencies. The method uses signals received by the transducer assembly to generate an echo profile for signals received at at least a first of the frequencies to enhance the recovery of data beyond that obtained from the first signal alone.

Claims:

8. (new) A method of operating a pulse echo ranging system comprising the steps of:

providing a transducer assembly operable to send and receive high frequency acoustic energy;

transmitting, through the transducer assembly, at least two energy pulses having substantially different frequencies;

receiving reflected echoes of at least two energy pulses at the transducer assembly and converting the reflected echo signals to received signals; and

combining the received signals to provide enhanced data.

9. (new) A method according to claim 8, wherein the received signals are summed.

10. (new) A method according to claim 8, wherein the received signals are differenced.

11. (new) A method according to claim 8, wherein a signal received at a second frequency is used as a reference against which the first signal can be compared to provide enhanced data.

12. (new) A pulse-echo ranging system including a control computer programmed to perform the method of claim 8.